MINISTRY OF HEALTH

ADVISORY COMMITTEE ON NUTRITION

FIRST REPORT

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Advisory Committee on Nutrition

CONSTITUTION AND TERMS OF REFERENCE OF COMMITTEE.

We hereby appoint—

The Lord Luke, K.B.E., J.P.
Mrs. Eleanor Barton, J.P.
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G. F. Buchan, Esq., M.D., F.R.C.P.
Professor E. P. Cathcart, C.B.E., M.D., D.Sc., F.R.S.
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E. C. Ramsbottom, Esq., O.B.E.
J. M. Vallance, Esq.
Mrs. Chalmers Watson, C.B.E., M.D.
J. R. Willis, Esq., M.C.
E. H. T. Wiltshire, Esq.

to be an Advisory Committee to inquire into the facts, quantitative and qualitative, in relation to the diet of the people, and to report as to any changes therein which appear desirable in the light of modern advances in the knowledge of nutrition.

The term of office will expire on the 31st July, 1938, and retiring members will be eligible for reappointment.

We further appoint the Lord Luke to be Chairman and Mr. W. J. Peete of the Ministry of Health and Mr. N. F. McNicoll of the Department of Health for Scotland to be Secretaries and Dr. H. E. Magee of the Ministry of Health to be Medical Secretary of the said Committee.

(Signed) E. Hilton Young,
Minister of Health.

(Signed) Godfrey P. Collins,
Secretary of State for Scotland.

30th May, 1935.

We hereby appoint T. W. Wade, Esq., M.D., Senior Medical Officer of the Welsh Board of Health, to be a member of the Advisory Committee on Nutrition appointed on the 30th May, 1935.

(Signed) KINGSLEY WOOD,
Minister of Health.

(Signed) GODFREY P. COLLINS,
Secretary of State for Scotland.

10th July, 1935.

We hereby appoint E. M. H. Lloyd, Esq., to be a member of the Advisory Committee on Nutrition which was appointed on 30th May, 1935.

Dated this twenty-fourth day of July, 1935.

(Signed) KINGSLEY WOOD,
Minister of Health.

(Signed) GODFREY P. COLLINS,
Secretary of State for Scotland.

We hereby appoint Miss Ruth Pybus to be a member of the Advisory Committee on Nutrition in the place of Mrs. A. M. Chalmers Watson, C.B.E., M.D., deceased.

Dated this 24th day of November, 1936.

(Signed) KINGSLEY WOOD,
Minister of Health.

(Signed) WALTER E. ELLIOT,
Secretary of State for Scotland.

The estimated gross cost of the preparation of this Report (including the expenses of the Advisory Committee) is £401 7*s*. 3*d*., of which £54 10*s*. 0*d*. represents the estimated gross cost of printing and publishing the Report.

ADVISORY COMMITTEE ON NUTRITION

FIRST REPORT

To the Right Honourable Sir H. KINGSLEY WOOD, M.P., Minister of Health, and

The Right Honourable WALTER E. ELLIOT, M.C., M.P., His Majesty's Secretary of State for Scotland.

SIRS,

We, the Advisory Committee on Nutrition, have the honour to submit this, our First Report.

I.—INTRODUCTORY.

1. **Terms of Reference.**—In 1931, a small Committee composed mainly of physiologists was appointed to "advise the Minister of Health on the practical application of modern advances in the knowledge of nutrition." The present Committee was appointed on the 30th May, 1935, by the Minister of Health and the Secretary of State for Scotland, with the following terms of reference—

> "To inquire into the facts, quantitative and qualitative, in relation to the diet of the people, and to report as to any changes therein which appear desirable in the light of modern advances in the knowledge of nutrition."

2. We have appointed three standing sub-committees:—

(1) Statistical,
(2) Economic and Social,
(3) Physiological,

and the sub-committees have themselves appointed further sub-committees for some special purposes. The Main Committee and sub-committees have held some 40 meetings.

We have not taken any formal evidence but numerous memoranda and publications have been submitted to us.

3. Our terms of reference are much wider than those of the former Committee, and involve investigations more comprehensive in scope and character and likely to prove more fruitful than any hitherto attempted. Two fundamentally different questions are proposed to which we are asked to furnish replies.

4. The first question is one of fact, what foods and what amounts of each are consumed by the nation, and how the total consumption of these foods is distributed among the individual men, women, adolescents and children of all sorts and conditions who make up the nation.

5. The second question—as to any changes which appear desirable—calls on the other hand, not for the laborious collection and competent handling of statistical material, but for a considered opinion, in the light of this material, on the application of the lessons of recent nutritional science to the feeding of the nation.

6. We believe that this is the first occasion in history that a comprehensive survey, statistical and physiological, of the diet of a whole nation has been set on foot by any Government.

7. **Scope of Report.**—In this first Report we are giving the results of our preliminary survey of the whole field. We are very far from having completed our investigations, and in several directions we have initiated large-scale inquiries which are only just beginning. But in view of the wide popular interest in food and nutrition we have felt it incumbent upon us to present this Report, sketching in outline the nature of the problem and the general picture we have formed of the present position.

8. The particular questions to which we have addressed ourselves are:—

(i) Is there sufficient food produced in and imported into the country to ensure for everyone a diet in conformity with the principles of modern knowledge?

(ii) Are the diets of different sections of the population adequate in every respect in the light of recent advances in the knowledge of nutrition?

(iii) Is the state of nutrition* of every section as good as it could be made by the application of modern knowledge?

9. In attempting to answer these questions, our first task was to collect all relevant information from existing records, to classify it, and to determine its limitations and defects. The next step was to devise and initiate plans to fill the gaps in our knowledge. The present Report is mainly an account of these activities.

10. We have conceived it to be our task to indicate in what directions changes in the nation's diet are desirable rather than to show how these changes can be brought about by economic or

* We have interpreted the term " state of nutrition " as applying to the physical and functional bodily condition only in so far as it is dependent on food.

political action. Although this Report is mainly a review of our work, we have prefaced it with two preliminary chapters, one dealing with present knowledge of nutrition, the other giving a general picture of the national food supply. Finally, we have drawn some tentative conclusions as to the changes in the national diet which appear desirable.

II.—RECENT ADVANCES IN THE KNOWLEDGE OF NUTRITION AND THEIR APPLICATION.

11. **The new Outlook in Public Health.**—During the past quarter of a century there has been taking place a change of attitude of far-reaching importance towards health problems. This development is finding expression in the adoption to an increasing extent of positive measures to promote health, whereas formerly the main concentration of effort was on improvement of environmental conditions and the cure of disease. The facts brought to light in the remarkable series of discoveries in the science of nutrition in recent years have quickened this change of outlook.

12. These discoveries, which are the result of experimental work and clinical observations, make it clear that if the diet is unsuitable, the body cannot be properly constructed, neither can it function effectively. Here, of course, we include the maternal diet during intra-uterine life.

13. Other factors such as the age incidence and the sequelae of infectious disease, the emotional state, occupation, housing conditions and amount of sleep and exercise also affect development and health. These factors, important as they are, fall outside the scope of our inquiry.

14. **The Modern Knowledge of Nutrition.**—Before the principles of the recent knowledge of nutrition were established, conceptions of human nutrition were confined almost entirely to protein and energy requirements, and to the mode of utilisation of proteins, fats and carbohydrates by the body. Recent discoveries have shown that various mineral elements and vitamins play roles as essential in the economy of the body as those played by the proteins, fats and carbohydrates, and, in addition, that proteins of animal origin are generally of higher nutritional value than those from the vegetable kingdom. That is to say, they are superior for the construction of the body and repair of tissues. It is now well known that deficiency of suitable protein or of any one of the essential mineral elements or vitamins results in a disorganised state of nutrition. Some of these conditions, such as florid rickets and scurvy, are well defined and easily recognisable, while clinical and

experimental evidence is accumulating which suggests that many vague disturbances of health may be related to slight dietetic errors. We believe that better physique and health can be obtained and resistance to disease increased by the application to human diets of recent knowledge which demonstrates the importance of certain classes of food for proper nutrition.

15. *" Protective " Foods.*—The term " protective " in relation to foods was originally given by McCollum to milk and green vegetables because they correct the most common deficiencies of diets and thereby " protect " the consumer against such deficiencies. Liver, other glandular tissues and eggs are sometimes described as protective foods but they cannot replace milk and green vegetables, the protective foods properly so called. Although the word " protective " as frequently used at present has lost its original meaning to some extent, it is nevertheless a convenient collective term to apply to foods rich in those nutrients which research has shown to be essential for health. In short, the recent advances in knowledge of nutrition consist chiefly in the series of facts which have been revealed concerning the physiological roles of the foods now designated " protective." The most important of these foods are milk (and milk products), green vegetables, fruit and eggs.

16. **Application of Recent Advances in Nutrition.**—The new facts which have been brought to light are so numerous and so difficult for the layman to grasp that the application of this knowledge might be supposed to be impossible by the majority of people. Fortunately, the practical application of this knowledge can be expressed in a few simple statements. The most essential is that correct feeding is more important for expectant and nursing mothers and young children than for other members of the community, and the younger the child the more important it is that it should be properly fed, for the effects of a dietary deficiency during childhood or adolescence may persist through life. Finally, inclusion of adequate quantities of the protective foods in the diet will ensure correct nutrition, since, given adequate resources, most people instinctively consume sufficient of the energy-giving foods. The practical application of the recent advances in the knowledge of nutrition, therefore, consists simply in the inclusion in the dietary of the whole community of sufficient amounts of the protective foods; this is especially important for mothers and children, on whose good health the future of the nation depends.

17. **Results of the Application of Modern Knowledge of Nutrition.**—The public health services, whose aim is the maximum of well-being for the whole community, have been

adopting and applying these discoveries to practical health problems. During the last quarter of a century, the general death rate, the infant mortality rate and the death rate from tuberculosis have fallen. Gross rickets has become less common, chlorosis has almost disappeared, and the physique of school children has been steadily improving. Amongst the factors contributing to these advances in the public health are the efforts of the public health services to secure the application of the discoveries in nutrition, and the improvement in the national dietary as a result of the general rise in the standard of living, combined with the greater availability of foods of the right kinds, such as butter, cheese and fruit.

18. The diet of the people is now more in conformity with physiological principles than it was in pre-war years, and one of the reasons for this advance is the educational work on nutrition carried out in health clinics and in schools throughout the country. The Health and Education Departments of the Government have played their part in this work by the issue of memoranda and instructions on nutrition to Local Authorities. Amongst these publications, special mention must be made of the Memoranda issued by the former Advisory Committee on Nutrition, " The Criticism and Improvement of Diets "* and " Diets in Poor Law Children's Homes."* Local Authorities have derived considerable advantage from these memoranda, not only in the revision of diets in institutions and open-air schools, but also in instructing mothers and the older school children in dietetics. The careful attention given by Local Authorities during the past decade to the state of nutrition of mothers and children, and the giving of milk, meals, and other supplements, free, or at reduced cost, have unquestionably led to improvements in the national dietary and thus have had beneficial effects on the health of the people.

19. Although much has been achieved, much still remains to be done before the general health and physique of the population reach the optimum level. It must not, for example, be overlooked that in 1935, tuberculosis was still responsible for 32,903 deaths (England, Scotland and Wales), 6·1 per cent. of the total mortality, or that the mortality rate from all causes in children aged one to four years, favourable as is its trend, is distinctly higher than that of certain other countries, notably Norway, Sweden and the Netherlands. Moreover, the numerous milk feeding experiments which have been carried out demonstrate how physique in childhood might be improved. There is thus ample room for further progress, and we believe that the improvements in diet referred to will play an important

* H.M.S.O., 1932, price 3*d*. net.

part in attaining this end. The science of nutrition is, however, still in its infancy and future research will undoubtedly make many more contributions to knowledge which will be of lasting benefit to mankind. But, even now, sufficient facts have been accumulated to justify the hope that their general application would result in improved health, physique, and increased resistance to disease.

20. **International Recognition of the Significance of Recent Knowledge of Nutrition.**—The significance of the science of nutrition is now realised in all civilized countries, and the increasing attention which Governments have been giving to the subject culminated in its being discussed at the Assembly of the League of Nations in September, 1935. Since that time the Health Committee of the League has issued several reports on the subject; one of these, that on the Physiological Bases of Nutrition (June, 1936),* will be referred to later. The delegates agreed that the diets of many people, even in the most prosperous countries, fall short of that degree of perfection which we know is desirable. The fact that the United Kingdom cannot be excluded from this generalisation has been obvious for many years to the Health Departments of the Government and to Local Authorities, as well as to research workers in nutrition. In fact, many of the public health measures which have been adopted in recent years, such as the provision of milk for mothers and children, are in themselves an admission that the home diets of some sections of the people fall short of the requirements which are essential for health.

III.—THE NATION'S FOOD.

21. **Food Consumption in 1934-5.**—It is by no means easy to say what is the total quantity of each food consumed by the population of the United Kingdom.† At our request careful estimates have been compiled by Departments for the two years 1934 and 1935, and owing to seasonal variations in home production, particularly of fruit, we decided to take the average of these two years (see Table 1, page 13, and Appendix I). Fresh milk, potatoes and certain vegetables are the only foods produced almost entirely in this country, but nearly 90 per cent. of the fish and nearly 70 per cent. of the eggs in shell consumed in this country are derived from home sources. Rather more than half the total meat consumed is imported, and about 70 per cent. of the cheese and sugar,

* Ser. L.o.N.P. 1936. II.B.4.

† The available data all relate to the United Kingdom and not to England and Wales and Scotland separately.

and 90 per cent. of the cereals and fats. The United Kingdom is the largest food-importing country in the world, and this fact has been associated with a relatively high standard of food consumption. It is significant that the chief contribution of home agriculture has been in the supply of foods of special importance for nutrition—milk, green vegetables and potatoes.

22. **Changes in Consumption.**—Comparison of these estimates of total food supplies with similar estimates for earlier periods (see Table II, page 16) shows that for many years, (except during the war), there has been a progressive increase in the consumption per head of most foodstuffs, and that the increase has continued since the war. The chief exception is the consumption of cereals, which has fallen by nearly 10 per cent. since 1909-13. This fact, taken in conjunction with the increased consumption of other foods, is evidence of improvement in the national dietary and of a rise in the standard of living. But there is one important exception to the general improvement—consumption of liquid milk per head of the population apparently declined slightly between 1909-13 and 1934-35. This decline has been approximately off-set by a four-fold increase in the consumption of dried and condensed milk; but it remains true that consumption of milk in all forms per head of the population is too low.

23. **Comparison with Optimum Standards.**—Our next objective was to compare the quantities of food available with the nutritional requirements suggested by the Technical Commission* of the League of Nations Health Organisation. It is not easy to make an exact comparison, partly because the League Commission was, of course, unable to prescribe optimum quantities for all foods, and partly because no precise allowance can be made in the statistics relating to foods available for consumption to cover wastage in distribution and in the home. However, a very rough comparison has been made with the following results:—

(a) *Calories.*—It has been computed that in the average of the years 1934 and 1935 the national food supply contained 55,700 thousand million calories, or, allowing for a wastage of 10 per cent., 50,100 thousand million calories (net), as compared with total estimated net requirements for the population of 44,300 thousand million calories on the basis of the Report of the League Commission. Thus there is

* Referred to throughout this Report as " the League Commission."

a fair margin of calories available over calories required, and we regard this result as having satisfactory significance. We conclude from this and from the results of dietary surveys that there is no lack of energy-giving foods in the national food supply. In our opinion, all—except a relatively small fraction of the population—are obtaining the full amount of calories they require.

(b) *Fats.*—The marked increase in consumption of fat which has occurred in recent years suggests that there is no aggregate deficiency in the national diet; but there is some deficiency among the very poorest.

(c) *Proteins.*—The total protein supplies of animal and vegetable origin are estimated at 1,490,000 metric tons,* or allowing for an over-all wastage of 10 per cent., 1,340,000 metric tons. Requirements based on the League Commission's recommendations have been computed at 1,180,000 metric tons. We may conclude, therefore, that the national diet contains a sufficiency of protein; but this conclusion is subject to the qualification that the consumption of animal protein increases while that of vegetable protein remains nearly constant as the standard of living rises with income. Although there is no recognised standard requirement of animal protein, it is probable that there is some shortage of this constituent in the diets of the poorest section of the community.

(d) *Milk.*—The most significant comparison between national consumption and the League Commission's recommendations first made in its preliminary Report in December, 1935, relates to liquid milk. In view of the nutritional importance of milk, particularly for mothers, children and adolescents, we prepared a special memorandum entitled " The Nutritive Value of Milk,"† which was published in March, 1936 (*vide* Appendix II). We have computed that the requirements suggested by the Commission and adopted in our Memorandum are equivalent to an average allowance per head of the population of the United Kingdom of seven-eighths of a pint of liquid milk daily. The present national consumption of liquid milk is less than one half of this amount. If condensed and dried milk are included, the national consumption is still only 60 per cent. of the amount suggested by the Commission. We

* A metric ton=1,000 kilos or 2,204 lbs.

† H.M.S.O., 1936, price 3*d.* net.

regard this deficiency with special concern and we find it necessary to refer to it repeatedly throughout our Report.

(e) *Fruit and Vegetables.*—As regards other foods, the nutritional optimum is less easy to define and we prefer at this stage to make no quantitative comparisons, especially since the League Commission has not suggested any standard requirements. There is, however, good reason to believe that the national consumption of fruit and vegetables is below the nutritional optimum, and that this deficiency is predominantly to be found in the poorer sections of the population.

24. **Recommended Increase of Milk Consumption.**—We have expressed the opinion in our Memorandum on " The Nutritive Value of Milk " that the desirable amount of milk for children is from one to two pints per day, for expectant or nursing mothers about two pints per day, and for other adult members of the community half a pint of milk daily. If these quantities were consumed, the present consumption of liquid milk would be at least doubled.

25. In this connection it is not for us to discuss the vexed economic and political questions involved in the control of the price of liquid milk, but we deplore the fact that, while the volume of milk offered for sale is growing and there is a substantial surplus which it is beyond the capacity of the liquid milk market to absorb, there should be at the same time a severe deficiency of milk in the diet of large sections of the population. That under-consumption of a foodstuff so important as milk should exist in a country so eminently suited for milk production, is a matter towards which we cannot remain indifferent.

26. In recent years, measures have been taken to provide milk, free or at a reduced price, to necessitous mothers and children, including necessitous school-children. The Milk-in-Schools Scheme, which enables children of school age to get one-third of a pint daily for a half-penny, is another important step in the right direction. These measures are valuable so far as they go; but they do not provide sufficient milk for all mothers and children who need it, and very little provision is made for adolescents.

27. We hope that in dealing with the problem of milk, now and in the future, the primary objective of the State will be

to ensure that a supply of safe milk, to the amount we have recommended in paragraph 24 above, is brought within the purchasing power of the poorest.

28. The national advantages of an improved standard of health for the rising generation cannot be expressed in pounds, shillings and pence; but even from the point of view of industrial efficiency, it is not over-stating the case to say that a high general standard of physical well-being is the nation's greatest asset.

29. From the health standpoint there is no other single measure which would do more to improve the health, development and resistance to disease of the rising generation than a largely increased consumption of safe milk by mothers, children and adolescents.

IV.—FOOD STATISTICS.

30. **Total Food Supplies.**—No official statistics as to the total food consumed in the United Kingdom are regularly compiled and published, but the Market Supply Committee provided us with the preliminary results of its study of the market for various foodstuffs, in the course of which it had made estimates of total food supplies in 1934 and 1935. These estimates have been revised in consultation with the Board of Trade and the Agricultural Departments and are given in full in Appendix I. They are summarised in Table I, which shows also the approximate percentages of imported and home produced food.

31. The chief elements of uncertainty in estimates of total food supplies are the allowances to be made for milk used on the farm, for eggs, fruit and vegetables produced in private gardens and on holdings of less than one acre, and for home grown food consumed in the farmers' own households.

Table I.

Foodstuffs for Human Consumption—United Kingdom. Average of the two years 1934 *and* 1935.

	Total. *000 tons.*	*Per cent.* *Imported.*	*Per cent.* *Home* *Produced.*
Flour from wheat and other cereals	4,427	87	13
Meat (including bacon)	3,062	51	49(*a*)
Fish (excluding freshwater fish) ...	953	12	88(*b*)
Milk (million gallons)	910	—	100(*a*)
,, Condensed and dried	253	38	62(*a*)
Cream	37	11	89(*a*)

	Total. *000 tons.*	*Per cent.* *Imported.*	*Per cent. Home Produced.*
Fats (butter, lard and margarine) ...	888	92	8(*a*)
Cheese...	203	69	31(*a*)
Eggs	430	39	61(*a*)
Fruit	2,432	77	23
Potatoes	4,629	3	97
Other Vegetables	2,425	25	75
Sugar	1,958	73	27

(*a*) Partly dependent on imported feeding stuffs.

(*b*) After allowing for herrings exported. Home produced fish means British takings landed by British vessels.

32. As already observed, fresh milk and potatoes are the only foods produced almost entirely in this country. More than half of the fish, vegetables other than potatoes, eggs, cream and condensed milk are produced at home. Rather more than half the total meat supplies, about 70 per cent. of the cheese and sugar, nearly 80 per cent. of the fruit, and about 90 per cent. of the cereals and fats are imported.

33. In terms of energy value or calorie equivalent,* home production represents about 40 per cent. of total consumption; but reckoned in terms of retail value it is estimated by the Market Supply Committee that home produced food is nearly half the total supply. The latter estimate is more significant for our present purpose since many of the foods of special nutritional value are expensive in relation to their energy value (particularly milk, eggs and vegetables). Home produced livestock products —meat, eggs and dairy produce—depend, however, to a considerable extent on imported feeding stuffs. It has been roughly estimated that about a quarter of the home produced meat and milk is produced from imported feeding stuffs.

34. **Wastage.**—The figures in the above Table are the gross figures of supplies available without taking into account wastage in distribution. The amount of wastage varies with every food and is difficult to estimate accurately. In order to translate the gross quantities of food available for consumption and of food purchased into their equivalent nutritive values, however, the necessary allowances must be made for wastage. Wastage takes place both before purchase by the consumer and in the household after purchase. In the case of meat, some of the bones in the dressed carcase are not sold to the consumer, the proportion being greatest for beef, where it is estimated at 15 to

* On the scale adopted by the Committee of the Royal Society on Food Supplies of the United Kingdom in 1916.

20 per cent. In regard to wastage in the home, for example, it was found in a dietary survey of 50 families in Newcastle-upon-Tyne* that bones and other portions of meat not eaten amounted to about 10 per cent. of the quantity prepared for consumption. Inedible portions of potatoes, other vegetables and fish amounted to about 20 per cent. and of fruit to 23 per cent. Moreover, unknown amounts of food are consumed by cats and dogs. For these reasons the figures in Tables I and II are an over-estimate of the amount of food actually consumed by the population.

35. **Consumption per Head in 1934-5 compared with 1924-8 and 1909-13.**—It is of interest to compare figures of total food supplies in 1934-5 with similar estimates for past years. In Table II overleaf, foods available for consumption per head per week for the United Kingdom in 1934-5 are compared with the average of the five years 1924-8 and the average of 1909-13, as estimated by Sir Alfred Flux in 1930.† It should be noted that in 1909-13 the United Kingdom included the area and population of what is now the Irish Free State. Allowance has, of course, been made for the change in the numbers of the total population of the United Kingdom at the various dates; but it has not been possible to estimate the probable effect of the change in the consumption habits of the population caused by the transference of the Irish Free State, a predominantly rural area, from the United Kingdom. This factor mainly accounts for the apparent fall in the consumption per head of potatoes (see footnote below).‡

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* Unpublished results.

† Journal of the Royal Statistical Society, Vol. XCIII, Part IV, 1930.

‡ If food consumption in the Irish Free State, as given by the High Commissioner for the Irish Free State for the year 1934–5, is added to the United Kingdom figures, the comparison between 1909–13 and 1934–5 is as follows :—

Consumption per Head per Week—British Isles 1909–13 and 1934–5.

	1909–13.	*1934–5.*	*Percentage Increase (+) or Decrease (—) 1934–5 on 1909–13.*
Meat	2·58 lb.	2·75 lb.	+ 6·6
Cereals (including wheat and flour)	4·45 lb.	4·10 lb.	— 7·9
Potatoes	4·68 lb.	4·63 lb.	— 1·0
Other Vegetables	1·38 lb.	2·25 lb.	+ 63·0
Milk and Cream	3·46 pints	3·33 pints	— 3·8
Eggs	1·93	3·03	+ 57·0
Butter	0·30 lb.	0·51 lb.	+ 70·0
Sugar	1·52 lb.	1·79 lb.	+ 17·8
Fish	0·79 lb.	0·83 lb.	+ 5·0
Tea	0·12 lb.	0·18 lb.	+ 50·0

TABLE II.

Consumption per head per week—United Kingdom, 1909–13, 1924–8 and 1934–5.

—	1909–13.	1924–8.	1934–5.	Increase (+) or Decrease (−) of 1934–5 compared with 1909–13.	Increase (+) or Decrease (−) of 1934–5 compared with 1924–8.
	lb.	lb.	lb.	per cent.	per cent.
Meat (including poultry, etc.)	2·58	2·56	2·81	+ 9	+ 10
Cereals (including wheat and flour)	4·45	4·11	4·04	− 9	− 2
Potatoes	4·68	4·43	4·25	− 9	− 4
Other Vegetables ...	1·38	1·81	2·22	+ 61	+ 23
	pts.	pts.	pts.		
Milk and Cream ...	3·46(*a*)	3·35(*a*)	3·26	− 6	− 3
	lb.	lb.	lb.		
Condensed Milk ...	0·05	0·14	0·23	+360	+ 64
	No.	No.	No.		
Eggs, in shell ...	1·93	2·34	2·90	+ 50	+ 24
	lb.	lb.	lb.		
Butter	0·30	0·31	0·49	+ 63	+ 58
Margarine	0·11	0·23	0·15	+ 36	− 35
Cheese	0·14	0·18	0·19	+ 36	+ 6
Lard	0·08(*b*)	0·11(*b*)	0·18	— (*c*)	— (*c*)
Sugar	1·52	1·60	1·79	+ 18	+ 11
Fish...	0·79	0·80	0·87	+ 10	+ 9
Fruit	1·19	1·75	2·23	+ 87	+ 27
Tea	0·12	0·17	0·18	+ 50	+ 6

(*a*) These estimates for milk may be somewhat too high.

(*b*) Lard made in the United Kingdom is included in meat.

(*c*) Not comparable.

These figures include wastage in distribution and in the home and consumption by domestic animals.

36. The consumption per head of most foodstuffs has increased since before the war. The largest proportionate increases have been in condensed milk, fruit, butter, vegetables (other than potatoes), eggs, tea, margarine and cheese. Large increases in the consumption of condensed milk and butter have also taken place during the last ten years. The consumption of butter and margarine together is now 56 per cent. higher than before the war. The consumption of cereals has fallen by nearly 10 per cent. since 1909-13, and that of milk and cream by about 6 per cent.

37. **Trends of Milk Consumption.**—During the year ended 30th September, 1934, according to the statistics of the Milk

Marketing Boards* about 950 million gallons of milk were sold off farms in Great Britain. Of this total, about 700 million gallons were absorbed by the liquid milk market and 250 million gallons went for manufacture. In the following year ended 30th September, 1935, the quantity sold into the liquid milk market was 745 million gallons, and the quantity sold for manufacture 361 million gallons. It is estimated that in the year ended 30th September, 1936, 753 million gallons were sold into the liquid milk market and the amount used for manufacture was 410 million gallons. Thus, there has been an increase of 64 per cent. in the quantity used in manufacture since 1934. This milk is, of course, utilised for the preparation of cheese, butter, condensed milk, fresh cream and other products all of which are intended for human consumption.

38. The total supply of liquid milk for human consumption in the United Kingdom (including the amount consumed in farm households), which is estimated at 910 million gallons a year for 1934-5, (see Table I), together with the liquid milk equivalent of condensed and dried milk, amounts to not more than half a pint per head per day. This figure is low compared with the estimated milk consumption in certain other countries, notably Scandinavia and the United States of America.

39. The need for an increase in the consumption of milk per head is a matter to which special attention is directed in Sections III and VI. One factor which may have contributed to the fall in milk consumption per head is a change in the age distribution of the population, the proportion of children being less now than before the war, and more milk being required by children than by adults. On the basis of the standard requirements which we have adopted,† the average standard milk requirement per head of the population fell by 7 per cent., which is practically the same as the percentage by which the consumption per head of fresh milk and cream apparently declined between 1909-13 and 1934-5. On the other hand, dried and condensed milk consumption has increased more than fourfold. It therefore appears that consumption of milk in all forms per head, standardised to a constant age composition of the population, actually shows a slight increase of about 4 per cent. Much of the dried and condensed milk, however, is used in confectionery and most of the remainder is in the form of condensed skimmed milk, which is not equivalent in its constituents to fresh whole milk.

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* It should be observed that Milk Marketing Boards' statistics of liquid milk consumption are about 10 per cent. lower than the estimate based upon agricultural returns and family budget inquiries, i.e., 2·8 pints per head per week compared with 3·1.

† See paragraph 24.

40. **General Conclusion from Food Statistics.**—The available information presented above indicates that although milk consumption per head has remained practically stationary at a low level, there has undoubtedly been a general improvement in the national diet since before the war.

41. **Conversion Factors.**—In assessing the value of the national food consumption in terms of the actual quantity of nutrients consumed, it is necessary to have reliable conversion factors for individual foods. An investigation was started by one of our special sub-committees to ascertain the proportions of protein and fat in different varieties of meat. Results so far obtained indicate that there are a higher proportion of protein and a lower proportion of fat in bacon and ham than in the earlier analyses of Atwater and Plimmer. Some details of this research are given in Appendix IV.

42. **Variation in Food Consumption at Different Income Levels.**—The object of the Market Supply Committee's study of the market for foodstuffs was to ascertain not merely total supplies and average consumption, but some measure of the probable variation in consumption at different income levels.* This information was needed in order to give a broad picture of the actual and potential market for foodstuffs both for the Market Supply Committee's own use in making recommendations under the Agricultural Marketing Act, 1933, and for the guidance of Marketing Boards and other bodies interested in securing increased consumption of particular foods. The data used in the Market Supply Committee's investigations comprised estimates of total consumption of and expenditure on each food, family budget material and an estimate of the distribution of the national income by income groups. Owing to the incompleteness of the data, many of the estimates are only rough approximations.

43. Our Statistical Sub-Committee was asked to report on (i) the adequacy of the available data for making estimates of food consumption at different income levels, (ii) the degree of probability attaching to the estimates of the Market Supply Committee and (iii) the data required for making a closer approximation to the true position.

44. After examining the data and the methods employed, the Sub-Committee did not discover any reason to suggest that the results arrived at by the Market Supply Committee are seriously misleading, or that they are more likely to err in one direction than another, but they realised that the results are based upon a slender foundation. The weakest point in the calculations

* See " Food Supplies and Consumption at Different Income Levels," by E. M. H. Lloyd, Journal of Proceedings of the Agricultural Economics Society, Vol. IV, No. 2, April, 1936.

is the uncertainty with regard to the distribution of working-class earnings, as to which no statistical returns are at present available. In general we are satisfied that no better estimates of variations in food consumption could have been made from the available data.

45. It is clearly impossible to determine with absolute precision the average level and variability of food consumption in different income groups since this would require a knowledge of the diets of millions of households. With the present relative paucity of data and the consequent complexity and uncertainty of many of the detailed calculations, it is certainly possible that there may be a considerable margin of error in the estimate of the average level of consumption of any particular article of food within any income group. On the other hand, the conclusions as to the broad trend of consumption of the different articles of food over the income groups appear to us likely to be in accordance with the facts. For example, the consumption per head of the more expensive foodstuffs which are those specially important for health—fresh milk, butter, meat, fish, eggs, fruit and vegetables (other than potatoes)—rises progressively with income; that of the cheaper staple foods, such as flour and potatoes, remains nearly constant, while the consumption of margarine and condensed milk decreases as income rises. The variation in consumption between the highest and lowest income groups is greatest in the case of milk, fruit and vegetables (other than potatoes). The consumption of meat varies less than that of fish or eggs. The highest consumption of tea, cheese and the fats (lard, suet and dripping) is reached in the middle groups, while sugar and jam increase at first and then remain fairly constant.

V.—PHYSIOLOGICAL BASES OF NUTRITION.

46. **Report of League Commission.**—At its 22nd Session in October, 1935, the Health Committee of the League of Nations resolved that a Technical Commission should be appointed to define the nutritional needs of the human being in the course of development from conception to the adult age, that is, the physiological bases for adequate nutrition. Three of our members (Professor Cathcart, Professor Mellanby and Sir John Orr) were appointed as members of the Technical Commission and Professor Mellanby was elected Chairman. Our Physiological Sub-Committee considered the first report of the Commission, issued in December, 1935, and made certain suggestions which were brought to the notice of the Commission. Most of these were adopted when the report was revised and amplified at the meeting of the Commission held at Geneva at the beginning of June, 1936. The revised report has also been considered and an extract from it is given in Appendix III.

47. The Commission endorses the earlier report by Drs. Burnet and Aykroyd, which reviews the position of nutrition in relation to public health in the civilised countries of the world, and concludes that deficiencies in protective foods occur frequently in modern diets. In Part I of the revised report, standards for energy and protein requirements are suggested. These do not differ materially from those agreed to by other authorities in recent years. The Commission did not express the standards for energy and protein in terms of actual foods, nor did it state how the energy requirements should be apportioned between protein, fat and carbohydrates. Part II of the revised report deals with mineral and vitamin requirements and thus embodies the outstanding discoveries in nutrition during the past 30 years. The needs for perfect nutrition are suggested in terms of specified quantities of the protective foods. The level of nutrition set by the Commission is the optimum level and to attain this sufficient quantities of the protective foods are essential. In order to emphasise the great importance of ensuring optimum nutrition for the coming generation, the Commission concentrated their attention in the first instance on children, and on expectant and nursing mothers.

48. The Tables appended to its report contain some simple schedules to show how a selection of common protective foods can be made to ensure safe intakes of the necessary proteins, minerals and vitamins for expectant or nursing mothers, for infants and for children up to 14 years. The selection of the additional foods necessary to provide the full quota of calories is left to the individual. No attempt is made to lay down a detailed dietary programme, or to suggest the wide range of protective and energy yielding foods whose selection will be influenced by availability, appetite and cost.

49. We note with approval that the Commission gives special emphasis to the importance of milk in the diet at all ages, and in its dietary schemes for pregnant or nursing women and for children up to the age of 14 years the Commission recommends the provision of large proportions of milk.

50. Subject to some minor reservations,* we desire to record our general agreement with the report. It aims at a high level of nutrition which, if widely adopted, would undoubtedly improve the health of the community and be of particular advantage to the rising and future generations.

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* We think that the recommended allowance of two grammes of protein per day per kilogramme of body weight for the nursing woman is on the high side, and that 1·5 grammes would be a more suitable allowance. No indication is given of the amount of fat which it is desirable that an adult should consume. We also deprecate the irradiation of milk which the Commission appears to have recommended or at least to have excepted from their general condemnation of indiscriminate irradiation. These matters will no doubt receive further consideration when the Commission again reviews the report.

51. **Application of League Commission's Suggestions.**—It is difficult to make a direct comparison between the recommendations of the League Commission and the diets of the different social groups of the population as a whole, because the Commission has not formulated a dietary schedule applicable to an average person. Some calculations from the data available have enabled us, however, to make some broad general deductions.

52. *Milk.*—For instance, it is possible to arrive at the approximate milk requirements of the average person in the population at the Commission's suggested level of nutrition on the basis of calcium intake, which is the basis of the estimate of seven-eighths of a pint daily mentioned in paragraph 23 (*d*).

53. *Eggs.*—As regards eggs, the present national average consumption is estimated to be 2·9 per head per week. The suggested schedules of the League Commission allow one egg per head per day for expectant and nursing mothers and one egg, or its equivalent, per day for children. On the assumption that the latter as well as the former have an average of one egg a day, then it is clear that, if the present total consumption is to remain unaltered, it would be impossible for the needs of these persons to be satisfied without reducing the supply of this valuable article of the diet available for the remainder of the population. To meet the requirements of the different sections of the population on the above assumptions, it would be necessary to increase the consumption from its present level to an estimated average of 3·9 eggs per head per week. The fact should be noted, however, that important though eggs be as articles of diet, there are other items in a mixed diet for children and adults, other than expectant mothers, which would complete an adequate diet, e.g. meat, fish, liver, etc. The selection of any of these alternatives may depend on economic considerations or personal preference, and we therefore do not feel justified in making any specific proposals in regard to the consumption of eggs by the population generally.

54. *Sea Fish.*—The League Commission recognises the importance of sea fish as a source of iodine. It is also a good source of protein of high nutritional value, of certain other minerals, and of the vitamins A and D. These vitamins are particularly abundant in fatty fish such as herring and mackerel. While it cannot be said that fish is indispensable for health, we have no hesitation in recommending the regular inclusion of some sea fish in the diet. The average national consumption of fish of all kinds is estimated at 8·9 ozs. net per head per week, but the consumption varies with income and is believed to be much less than this among the poorer sections of the population.

In the present state of knowledge we find it impossible to make any precise quantitative recommendation, but we suggest that the consumption should not fall below 8 or 9 ozs. net per head weekly.

55. *Potatoes.*—The League Commission states that " An extended dietary use of the potato is recommended to replace part of the sugar and highly milled cereals in the ordinary diet. Potatoes provide extra vitamin C and more readily available calcium and phosphorus than are present in cereals. Potatoes also yield more iron and B vitamins than milled cereals." We endorse this recommendation. The average consumption per head is in the region of 56 ozs. weekly at all income levels. We suggest that this consumption might be increased with advantage.

56. *Sugar.*—The Commission observes that the consumption of an excessive amount of sugar is to be condemned as it tends to lessen the proportion of protective foods consumed. Sugar is a rapidly utilisable source of energy but it does not possess any other food value, since it is devoid of any of the nutrients generally designated as constructive or protective. So far as is known, sugar is not detrimental to health when consumed in amounts ordinarily used for flavouring purposes, but it should not in practice be taken in large amounts in the fasting state. We agree that in these circumstances it dulls the appetite for more valuable foods and by leading to a deficient consumption of these it may influence nutrition adversely. It may also lead to a diminished consumption of the nutritionally more valuable foods by supplanting some of them as sources of energy. It would, however, be advantageous to know what amounts of sugar are adequate and what are excessive. There is no quantitative evidence on either of these points so that a precise statement about them cannot be made. It would appear from the available evidence that there has not been any appreciable increase in the national consumption of sugar since 1931.

57. *Energy and Protein Foods.*—In general, it may be said that where the energy content of the diet needs to be augmented it is preferable to increase the intake of bread rather than that of sugar, since bread contains some protein, appreciable quantities of important minerals and some vitamin B; and that where the diet is modified by increasing the protein intake in the form of milk, eggs, fish or meat any excess of energy that may result therefrom should be brought down to the standard requirements by reducing the intake of bread and sugar.

VI.—THE NUTRITIVE VALUE OF MILK AND MILK PRODUCTS.

58. *Milk.*—We attach such importance to milk that we prepared a special Memorandum, which was issued in March 1936 under the title of " The Nutritive Value of Milk," setting forth its value as a food, and for completeness we reproduce the Memorandum in Appendix II of this Report.

59. Milk is of such outstanding value that the consumption of a sufficient quantity of it may be regarded as the key to proper nutrition. Every one of the constituents of milk possesses high nutritive value and it is, therefore, most desirable that all of these should be utilised for human nutrition, more especially because the diets of many people are deficient in the nutrients supplied by milk and certain of its products. Moreover, cows' milk, the most complete food known, is elaborated from vegetable matter of little or no value for human nourishment, but this excellent food is not always put to the best use since large quantities of the so-called by-products of milk manufacture, particularly skimmed milk and buttermilk, are either fed to animals or wasted.

60. *Cream and Butter.*—Cream and butter are preparations containing higher concentrations of the fat and vitamins A and D than milk itself. It is on these constituents that the food value of cream and butter chiefly depends. As they are not complete foods the proper place for cream and butter is as items in a mixed diet in which they make good the deficiencies of other foods in fat and in vitamins A and D. The fats of milk are so constituted as to be especially valuable for human nutrition.

61. *Cheese.*—Cheese is manufactured from milk by straining off the coagulum, formed by previous treatment with rennet, and subjecting it to pressure. The milk is usually inoculated beforehand with certain bacteria, the propagation of which imparts to the finished product certain characteristic properties. Cheese, then, consists of milk, less the whey, which is drained off. It contains practically all the fat with its attendant vitamins A and D, the bulk of the protein and much of the calcium and phosphorus. Most of the other constituents of milk are separated with the whey. The nutritive properties of cheese, therefore, are principally those of the fat, protein, calcium, phosphorus and vitamins A and D of milk.

62. The chemical composition of an ordinary hard cheese is given in " The Nutritive Value of Milk " (Appendix II), but the composition varies within fairly wide limits according to the kind of cheese. For ordinary purposes, hard whole-milk cheese may be regarded as containing roughly equal parts of protein, fat and

water. Soft (e.g. packet) cheeses are often made by incorporating additional water into hard cheeses, and thus contain a higher proportion of water and correspondingly smaller proportions of protein and fat. Skimmed milk cheeses are made from various mixtures of whole-milk and skimmed milk; the amount of fat in skimmed milk cheese is naturally less than in whole-milk cheese and varies according to the proportion of skimmed milk used.

63. Cheese possesses some important advantages over liquid milk; it is much more concentrated and it can be kept for considerable periods. Cheese can be recommended as a very valuable food, either uncooked or as an ingredient in cooked dishes.

64. *Skimmed Milk.*—In the above-mentioned Memorandum brief reference was made to skimmed milk; but in view of the widespread belief that skimmed milk possesses little or no nutritive value we consider it desirable to discuss its properties in greater detail.

65. There is a fairly general impression that all the nourishment that is in the whole milk is removed with the fat. This is not so, for skimmed milk stands next to whole milk in the order of nutritive value of foods and differs from the latter only in so far as it contains very little of the fat with its attendant vitamins A and D. Except for these three nutrients, skimmed milk contains all those present in whole milk, or, in other words, all the remaining materials required for the nutrition of the body, viz., the protein, carbohydrate, vitamins B, C, and E, and inorganic elements. As with whole milk, however, a statement of the chemical constituents of skimmed milk gives an imperfect idea of its nutritive properties because it leaves unmentioned nutritionally important physico-chemical and biological characteristics. Unfortunately, little of this valuable food is available for sale in liquid form in this country.

66. The bone forming properties of milk are dependent on the calcium, phosphorus and vitamin D present in it. Dietary surveys have suggested that calcium is deficient in many diets, a defect which can be remedied as well by skimmed milk as by whole milk. Calcium, phosphorus and vitamin D are each essential for the formation of bone, but there is little vitamin D in skimmed milk. If, however, a diet contains enough cream or butter, the lack of this vitamin in the skimmed milk included in that diet would be of no consequence, and the skimmed milk would have the same physiological value as whole milk.

67. There is wide scope for the utilisation of skimmed milk in cooked foods such as puddings, bread and cakes; this is a very commendable practice which might be more extensively followed. Of the skimmed milk produced in this country, some

is dried and sold as such, some is incorporated in foods such as bread, cakes and confectionery, some is fed to farm animals and much is wasted. We are glad to note that the Milk Reorganisation Commission in its recent Report* deplored the wastage of this valuable food, and that it deprecated any action which would tend to make it less readily available for human consumption. In view of the fact that the total production of milk is less than the amount required for the proper nutrition of the population, we cannot regard with satisfaction the conditions governing the sale of milk products which render such a highly nutritious food as skimmed milk not readily available to the public.

68. In view of the cost of distributing liquid skimmed milk, we suggest that the dried state is the most convenient form for general use. Moreover, in this state it can be kept for long periods and it has the additional advantage of being safe. Dried skimmed milk is particularly suitable for puddings, bread, cakes and confectionery. In some districts where difficulties of distribution do not arise it might be found more convenient to supply skimmed milk in liquid form.

69. While recommending that as much as possible of the national production of skimmed milk should be consumed by the people, we desire to make it clear that it is not a proper food for babies under one year because of the absence of fat with its attendant vitamins. For all other members of the community it is little inferior to whole milk as an item in a mixed diet, if this contains adequate amounts of butter and other fats. We do not, of course, suggest that skimmed milk should replace whole milk in the national dietary. It should be used to supplement whole milk and not to replace it in the diet.

70. *Buttermilk*.—Most of what has been said above about the value of skimmed milk applies also to buttermilk, which differs from the former in that a variable amount of the milk sugar has been converted into lactic acid and the proteins are present in semi-coagulated form. These differences do not, however, detrimentally affect its food value to any appreciable extent, so that we may regard buttermilk as almost equal in nutritive value to skimmed milk. It is worthy of note that buttermilk is widely used in human diets in other countries, and also that it is extensively employed in the baking of home made bread in Ireland.

71. *Whey*.—The belief that whey is of no significant nutritional value is erroneous. Undoubtedly it is inferior to skimmed milk, cheese, or butter, but it is nevertheless sufficiently nutritious to warrant its use in human diets wherever it is available.

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* Ministry of Agriculture and Fisheries Economic Series No. 44, page 279, H.M.S.O., 1936, price 1*s.* 0*d.* net.

Whey contains much of the sugar and minerals, and some of the proteins and vitamins of the milk from which it was derived, and, as an ingredient of foods made from cereals, it would go some way towards correcting the deficiencies in such foods.

72. *Safe Milk.*—This brief review of the nutritive properties of milk would be incomplete if reference were not made to the risks of contracting disease which may follow from the consumption of milk or skimmed milk in the raw state, and to the fact that milk can be made entirely safe by efficient pasteurisation or other heat treatment. We have drawn attention to this matter in " The Nutritive Value of Milk," (Appendix II, p. 37).

VII.—THE ASSESSMENT OF THE STATE OF NUTRITION.

73. We have endeavoured to obtain information as to the measurement of the state of nutrition as we considered that the correlation of the state of nutrition with the diet consumed would be of assistance to us in our inquiries.

74. We have had under review the various methods which have been tried or are in process of trial or have been suggested for the assessment of the nutritional state. We are unable to recommend any known method as reliable. So far as our present knowledge goes it would seem that the clinical method given in detail in Administrative Memorandum No. 124 of the Board of Education is the most promising, but the trial of this method has not been sufficiently prolonged to establish its reliability.

75. The League Commission has recommended that the assessment of the nutritional state of children should be a problem for further study and we are of opinion that the standardisation of tests for assessing the state of nutrition would be of assistance in connection with many of the problems of dietetics. We desire to record our view that research should be continued to establish, if possible, a reliable test or group of tests for the assessment of the state of nutrition.

76. We are gratified to learn that research work is being carried out by Local Medical Services in several parts of the country with the object of determining the value of various objective tests for the assessment of the state of nutrition.

VIII.—DIETARY IN POOR LAW INSTITUTIONS.

77. We have also been informed by the Ministry of Health that inquiries have been made to ascertain whether the recommendations contained in the Reports issued by the former Advisory Committee on Nutrition in 1932 on the " Criticism

and Improvement of Diets" and "Diets in Poor Law Children's Homes" have been generally adopted in Poor Law Institutions, and whether the changes have resulted in an improvement in the nutritional condition of the inmates. Although the dietaries in Poor Law Institutions do not require the approval of the Minister, the Ministry's General Inspectors, when visiting Institutions, continue to pay attention to the dietaries and have, on occasions, pointed out inadequacy by reference to those recommendations. The Reports were circulated to all Local Authorities and also to the voluntary homes certified for use by Public Assistance Authorities. Information has recently been specially obtained by the General Inspectors from each Public Assistance Authority regarding existing dietaries. We are informed that the great majority both of the County Councils and County Borough Councils have had the matter under consideration and have taken into account the recommendations referred to. A Medical Officer of the Ministry has visited a number of these Institutions, including Children's Homes, and has found the diet in many to be satisfactory and in others, when it has not been entirely satisfactory, suggestions for improvement have been made. His recommendations have been generally adopted.

IX.—FURTHER INVESTIGATIONS PROPOSED.

78. **Income Distribution.**—With a view to improving the statistical data as to the diet of the people, we have recommended (1) that the Ministry of Labour should take steps to obtain further information concerning the distribution of working-class earnings, and (2) that the Registrar-General for England and Wales should be asked to carry out an inquiry on a large scale into the constitution of families by age, sex, occupation and locality and, by means of estimates of occupational incomes to be made on our behalf by an independent statistician, into the distribution of family incomes. An inquiry on the lines mentioned in (2) above is already proceeding in Scotland at our suggestion. If these further investigations are carried out it should be possible to obtain a more reliable estimate of the distribution of the population in income groups than has hitherto been possible, and the results may be found to be of use in fields other than the purely nutritional with which we are concerned.

79. **Family Budgets.**—We have also passed a resolution that, having regard to the small amount of information at present available as to the actual consumption of food by different sections of the population, and in view of the importance of the issues involved, we consider it essential that early steps should be taken to collect family budgets and to undertake dietary surveys on a comprehensive scale, and that the appropriate Departments should co-operate in devising the machinery and

technique for the purpose. We were influenced in coming to this conclusion by the view of our Statistical Sub-Committee that the budget and dietary material used by the Market Supply Committee, while it was the best available at the moment, could not be expected to yield more than a rough indication of the variations of consumption and expenditure throughout the whole population.

80. It has since been announced that the Ministry of Labour will shortly undertake a family budget inquiry to provide the material required for a revision of the basis of the cost-of-living index. It is expected that the inquiry will provide much of the information which we require as to the quantities of the various kinds of food obtained by the families from whom the budgets are collected.

81. We recognise that even this larger collection of family budgets could only give rough indications of the way in which total food consumption is distributed among the whole population. For example, it is difficult to obtain from family budget inquiries particulars of food consumed away from home and family budgets do not, of course, cover food consumed by residents in hotels and institutions. On the other hand, family budgets supply essential data for estimating (1) the average ratio of food expenditure to total expenditure at different income levels and (2) the way in which expenditure on food is likely to be allocated between particular foods having regard to type of family, occupation, income group and district.

82. **Dietary Surveys.**—In order that full use may be made of this information for dietetic purposes it is necessary to know what is the proportion of domestic wastage for each kind of food. We are informed that some figures as to this will shortly be available as a result of the dietary surveys undertaken by local authorities in some urban areas in England. We think it desirable that these should be supplemented by figures for other areas, and we have therefore also recommended that exact studies of the diets of several hundred families should be carried out in England and Wales, principally in rural areas, and in Scotland.

X.—SUMMARY.

i. Our terms of reference involve a more comprehensive survey of the food supplies, diets, and state of nutrition of the population than any hitherto attempted in this, or any other, country (paras. 3-6).

ii. During the past quarter of a century increasing importance has been attached to positive measures for promoting health. Recent advances in the science of nutrition have shown that improvements in health and physique can be attained by

consumption of adequate amounts of the protective foods. This is especially important for mothers and children (paras. 11-16).

iii. The progressive application of this knowledge and the concurrent rise in the standard of living have contributed to the general improvement in health, and to the marked declines in the rates of mortality and in the incidence of deficiency diseases such as rickets. The greater availability of certain foods of special value for nutrition, such as butter, cheese, and fruit, and the increased attention given to the nutrition of mothers and children have also played a part in this trend (paras. 17 and 18).

iv. There is, however, much room for further improvement in the health and physique of the nation, and the more extensive application of recent discoveries in nutrition should result in new and higher levels of physical well-being (para. 19).

v. The national dietary contains sufficient energy-giving foods for the whole population. We conclude that all, except a relatively small fraction of the population, are obtaining the full amount of calories they require (para. 23 (*a*)).

vi. The consumption of fat has largely increased in recent years and this suggests that there is no aggregate deficiency in the national dietary; but there is some deficiency in the diets of the very poorest (para. 23 (*b*)).

vii. Consideration of the national food supply does not reveal a shortage of total protein. But all protein is not of the same nutritional value; the consumption of protein of high nutritional value (meat, dairy products and fish) rises with income. Although there is no recognised standard requirement of animal protein, it is probable that there is some shortage of this constituent in the diets of the poorest section of the community (para. 23 (*c*)).

viii. We have computed that the allowances suggested in the preliminary report of the League Commission (December, 1935), and adopted in our Memorandum on " The Nutritive Value of Milk ", are equivalent to an average consumption of milk per head of about seven-eighths of a pint per day. This level would represent a doubling of present consumption of *liquid* milk. The consumption of milk *in all forms,* which is about half a pint per head daily, is only 60 per cent. of the suggested amount (paras. 23 (*d*), 38 and 52).

ix. The average daily consumption of milk per head should be about two pints for expectant and nursing mothers, from one to two pints for children and not less than half a pint for the rest of the population (para. 24).

x. From the health standpoint there is no other single measure which would do more to improve the health, development and resistance to disease of the rising generation than a

largely increased consumption of safe milk, especially by mothers, children and adolescents, and we hope that in dealing with the problem of milk now and in the future, the primary objective of the State will be to ensure that a supply of safe milk, to the amount we have recommended above, is brought within the purchasing power of the poorest. We deplore the fact that there is a deficiency of milk in the diet of large sections of the population (paras. 25-29).

xi. It is very probable that the national consumption of fruit and vegetables is below the requirements for optimum nutrition (para. 23 (*e*)).

xii. Estimates of total food supplies in 1934-5 have been obtained from the Departments concerned. The main elements of uncertainty in these figures are the estimates made for food produced in private gardens and allotments, and food consumed by farm households (paras. 30 and 31).

xiii. Comparison with previous estimates made by Sir Alfred Flux for 1909-13 and 1924-8 shows that there has been a general improvement in the national diet since before the war, but the national average consumption of some of the protective foods has remained low, that of milk being practically stationary since pre-war years (paras. 22 and 36-39).

xiv. The figures of the total food supplies given in this Report are gross figures and take no account of wastage in distribution and in the home (para. 34).

xv. An investigation is being made with a view to obtaining improved data as to the nutritive equivalents of different varieties of meat. Preliminary results show that there are a higher proportion of protein and a lower proportion of fat in the bacon and ham supply than before the war (para. 41).

xvi. The broad picture prepared by the Market Supply Committee of the probable variation in consumption of particular foods, can only be a rough approximation in view of the incompleteness of the data, but in spite of the uncertainty and slender foundation of many of the estimates, the conclusions as to the broad trend of consumption of the different articles of food over the income groups appear to us likely to be in accordance with the facts (paras. 42-45).

xvii. We have examined, and, except for some minor reservations generally approve of all the recommendations set forth in the report of the Technical Commission of the League of Nations on the Physiological Bases of Nutrition. The Commission has set up a new and high level of nutrition which we have adopted (paras. 46-51).

xviii. Sea fish is particularly valuable as a source of good protein, of iodine and other minerals. Herring and mackerel are especially rich in vitamins A and D (para. 54).

xix. The present average consumption of potatoes is about 56 ozs. per head weekly. We recommend that the consumption should be increased, replacing some of the sugar and highly-milled cereals in ordinary diets (para. 55).

xx. We regard the consumption of a sufficient quantity of milk as the key to proper nutrition and we draw attention to our Memorandum "The Nutritive Value of Milk" which is reproduced as Appendix II to this Report (para. 58).

xxi. We deal with the nutritive value of cream, butter and cheese, and draw special attention to the nutritive value of the so-called by-products of milk manufacture, namely skimmed milk, buttermilk and whey. We are of opinion that as much as possible of these very nutritious products should be made available for human consumption, because the satisfaction of the nutritional needs of the people should be the predominant consideration concerning the disposal of these products (paras. 60-71).

xxii. We are unable to recommend any method of assessing the state of nutrition as reliable and we consider that research should be continued with a view to establishing if possible a reliable test or group of tests (paras. 73-76).

xxiii. We are informed that efforts are being made to remodel diets in Poor Law Institutions where necessary, so as to put into practice modern knowledge of the science of nutrition, a valuable step in this direction having been taken by the publication of the reports of the earlier Advisory Committee on Nutrition (para. 77).

xxiv. We propose the following further investigations:—

(*a*) Distribution of the National Income by Income Groups.

(*b*) Family Budget Material.

(*c*) Quantitative Dietary Studies (paras. 78-82).

XI.—ACKNOWLEDGMENTS.

We take this opportunity of recording our special indebtedness to the Market Supply Committee for its most valuable co-operation in the statistical aspects of our inquiries and to its staff who have carried out much statistical work on our behalf.

We also wish to record our appreciation of the very helpful advice given to us by other persons who have been co-opted as members of some of the Sub-Committees for the consideration of special problems, and to express our thanks to them and to others who have assisted us in our deliberations and inquiries. Our thanks are also due to the Health Organisation of the League of Nations, by whose courtesy the extract from the

Report on the Physiological Bases of Nutrition has been reproduced as Appendix III.

In conclusion we desire to record our cordial appreciation of the valuable services rendered to us by our Secretary, Mr. W. J. Peete, and our Medical Secretary, Dr. H. E. Magee, in their respective capacities.

Mr. Peete has carried out the arduous duties as a Secretary including the preparation of this report with great zeal and efficiency, and Dr. Magee with his intimate knowledge of the subject, especially in the preparation of a number of technical memoranda, has been of immense assistance to us in our consideration of the problems with which we have been faced.

It is with deep regret that we have to record the death in August, 1936, of Dr. A. M. Chalmers Watson, C.B.E. Her extensive knowledge and experience were of the greatest value to us in the consideration of the problem of nutrition generally, as well as in its technical aspects.

We have the honour to be,

Sirs,

Your obedient Servants,

LUKE (Chairman).

Eleanor Barton.	Donald Hunter.
J. N. Beckett.	E. M. H. Lloyd.
George F. Buchan.	E. Mellanby.
E. P. Cathcart.	John Orr.
R. R. Enfield.	Ruth Pybus.
J. Alison Glover.	E. C. Ramsbottom.
J. M. Hamill.	J. M. Vallance.
A. Bradford Hill.	T. W. Wade.
F. Gowland Hopkins.	J. R. Willis.

E. H. T. Wiltshire.

W. J. Peete,
Secretary.

H. E. Magee,
Medical Secretary.

5th March, 1937.

APPENDIX I.

Foodstuffs for Human Consumption: United Kingdom.

Average of the two years 1934 and 1935.

(Products manufactured from imported materials, e.g. flour, margarine and chocolate are treated as imported).

Commodity.	Home Production.	Per cent. of total supply.	Imports *less* total exports.	Total Quantities available for consumption.
Cereals—	000 tons.	Per cent.	000 tons.	000 tons.
Wheat flour	500	11·9	3,693	4,123 (*a*)
Barley meal	25	45·5	30	55
Oat products	50	50·0	50	100
Tapioca, Sago, etc. ...	—	—	50	50
Rice	—	—	57	57
Other cereals (e.g. macaroni, etc.)	—	—	42	42
Total cereals	575	12·8	3,922	4,427(*a*)
Meat—				
Beef and Veal (*b*) ...	635	52·8	566	1,201
Mutton and Lamb (*b*) ...	255	43·0	339	594
Pork (*b*)	217	79·2	57	274
Bacon and Ham (*b*) ...	153	27·5	404	557
Other meat	107	41·3	152	259
Poultry and Game ...	86	79·6	22	108
Rabbits	50	72·4	19	69
Total meat	1,503	49·1	1,559	3,062
Fish—				
Herrings	128(*c*)	100·0	—	128
Other fish, fresh or cured	702(*d*)	94·2	43	745
Shell fish (*f*)	8	72·7	3	11
Canned fish	(*e*)	—	69	69
Total fish	838	88·0	115	953
Milk and Dairy Produce—				
Milk, fresh (mln. gls.)	910	100·0	—	910
,, condensed whole ...	92	92·0	8	100
,, ,, skimmed	53	41·4	75	128
,, powder	13	52·0	12	25
Butter	53	10·0	476	529
Cheese	63	31·0	140	203
Cream	33	89·3	4	37
Lard	19	10·0	181(*g*)	200
Margarine	—	—	169	169
Eggs in shell (mlns.)	4,700	67·1	2,307	7,007
(,, ,,) (thous.tons)	(262)	67·1	(128)	(390)
Eggs, liquid, dried and frozen	—	—	40	40

Commodity.	Home Production.	Per cent. of total supply.	Imports *less* total exports.	Total Quantities available for consumption.
Fruit—	000 tons.	Per cent.	000 tons.	000 tons.
Apples	315(*h*)	49·9	316	631
Oranges	—	—	499	499
Bananas	—	—	324	324
Other fresh fruit ...	230(*h*)	43·6	298	528
Nuts	5	7·2	64	69
Dried fruit	—	—	175	175
Canned fruit	(*j*)	—	192	192
Desiccated coconut ...	—	—	14	14
Total fruit	550(*h*)	22·6	1,882	2,432
Fruit Pulp	—	—	28	28
Vegetables—				
Potatoes	4,500(*h*)	97·2	129	4,629
Dried beans, peas and lentils	15	10·2	132	147
Green lentils	200(*h*)	99·5	1	201
Other vegetables (including tomatoes and rhubarb)	1,600(*h*)	78·8	432	2,032
Preserved vegetables ...	(*j*)	—	45	45
Sugar, etc.—				
Sugar (in terms of refined)	530	27·9	1,368	1,898
Molasses	—	—	32	32
Glucose	—	—	24	24
Honey	1	25·0	3	4
Beverages—				
Tea	—	—	195	195
Coffee	—	—	15	15
Cocoa, Chocolate powder and Cocoa products ...	—	—	68	68

(*a*) Excludes 70,000 tons of wheat flour estimated to have been used for industrial purposes which cannot be distributed between home production and imports.

(*b*) Tinned meat and edible offals included in " other meat."

(*c*) Net landings after allowing for net exports of fresh or cured herrings and making further allowance for weight of containers of cured herrings.

(*d*) No estimate for fresh water fish has yet been made.

(*e*) Included in fish above.

(*f*) Estimated edible portion only.

(*g*) Includes 65,000 tons of imitation lard manufactured in the United Kingdom from imported raw materials.

(*h*) Includes allowance for allotments and private gardens.

(*j*) Included in fresh fruit or vegetables.

APPENDIX II.

THE NUTRITIVE VALUE OF MILK.

A food which contains all the materials essential for growth and maintenance of life in a form ready for utilisation by the body is obviously of high value. Milk alone is the food which in itself nearly fulfils these conditions, being elaborated by the mammalian mother as the sole nutriment of her offspring during the period of most rapid growth.

Mothers' milk is the ideal food for the young of the same species, but it is not quite ideal for the young of another species. Next to milk of the same species that of another is the best food for the nutrition of young mammals, since the composition of the bodies of mammals and the nature of their living processes are fundamentally the same. The milk of any species of animal, provided it is palatable, is also an eminently suitable food for human beings, especially during growth, pregnancy and lactation. Cows' milk is usually consumed by human beings, but there is no biological reason why that of other animals should not also be used.

The Composition of Milk.

The chemical composition of cows' milk is shown in the first line of Table I. It contains the energy-giving nutrients, protein, fat and carbohydrate; all the known essential vitamins; calcium, phosphorus, iron, sulphur, iodine, magnesium, potassium, sodium, chlorine and copper, some of the physiological roles of which are known; and a number of other elements, present only in minute amounts, such as manganese, zinc, and fluorine, the exact functions of which are not fully understood, but which would seem to be as necessary for normal nutrition as any of the other constituents. Even if it were possible to state the chemical composition of milk in full a very imperfect idea of its nutritive value would be obtained, because it would leave unmentioned many important physico-chemical and biological properties on which its high nutritive value largely depends. For example, the physico-chemical states of its constituents make for easy digestion and assimilation; the relationship of the different constituents to one another ensures normality of bodily function; the nature of its protein and of its mineral elements, notably calcium and phosphorus, and its high content of other inorganic elements and vitamins make for satisfactory growth and give it a very high value as a protection against disease.

Nutritive Value.

The fact that milk is a valuable human food, particularly when new tissues are being formed, has been recognised from the earliest times. Within recent years much experimental evidence has been brought forward, which has shown that cows' milk is the most valuable food known for the promotion of growth and health in children. Some of these investigations, like those of Mann in this country and McCollum and others in the United States, have been carried out under carefully controlled conditions in residential institutions. Others, like those of Orr and Leighton, and Leighton and McKinlay in this country and of other workers in New Zealand, France and Japan, have been carried out on large numbers of school children living at home. The general conclusion to be drawn from these investigations without exception is that milk is an essential item in the diets of children for optimum growth, physique and the maintenance of health. Many other investigations have been carried out in institutions and elsewhere in this country by M. Mellanby and her colleagues, and in the United States by Davies, Bunting and others, the results of which have shown that milk is all-important for the development of normal teeth resistant to dental caries. From the results of these and many other experiments too numerous to

mention, on man and animals, it can be predicted that important beneficial effects would result from an increase in the consumption of milk above that at present prevailing in this country. The present consumption of liquid milk is somewhere in the region of 0·4 pint per head per day, on the average, but the information obtained from dietary surveys has shown that the consumption in very many families is well below this figure. There can be little doubt from the experimental evidence obtained that an increase in the average consumption of milk to about one pint per head per day would result in the improvement of the general health of the community, especially in the case of children, in whom it would secure better bone formation and improvement in stature and physique. It would diminish the incidence of disease, including rickets, and increase resistance to dental caries.

Milk as an Article of Diet.

Milk is in itself a well balanced mixed diet. Its few disadvantages, which vary with the age of the person for whom it is intended, are easily overcome. All babies should be brought up on their mother's milk, but after breast feeding ceases, although cows' milk ought to form the bulk of the diet, this should be supplemented with iron, vitamins D and C, preferably given in the form of natural foods, such as egg-yolk, orange juice and cod-liver oil. For children, adolescents and adults a diet of milk alone is undesirable because it is deficient in energy-giving constituents relative to its bulk. For these it should be regarded as an important item in a mixed diet and not as a complete food; but on account of its growth-promoting properties it should form a larger proportion of the diet of children and adolescents than of that of adults. The expectant mother has to elaborate from her food the materials necessary for the growth of her offspring, while the nursing mother has to secrete milk to serve as the only food of her infant for at least six months. The milk requirements of the expectant or nursing mother are of a similar order to those of the growing child.

Amounts of Milk Required.

The desirable amount of milk for children would seem from investigations of Sherman, Daniels and others to be from one to two pints per day, and for expectant and nursing mothers according to Mellanby and others it is about two pints per day. In regard to other adults there is a consensus of opinion that enough milk or milk products should be consumed to secure a sufficiency of calcium. Dietary surveys have shown that calcium and animal protein are very frequently deficient in diets in this country, but while deficiencies of animal protein can be made good by meat, fish or eggs, the best and most convenient means of assuring a sufficiency of calcium is by including in the diet an adequate amount of milk, which would of course enrich the diet with all the other valuable nutrients, including protein, present in milk. It would seem that a minimum of 0·5 pint of milk daily is desirable for an adult.

The Effect of Heat on Milk.

The effects of heat on the nutritive value of milk for animals have been extensively studied, but the few human experiments that have been done have not shown that heat significantly lowers the food value of milk for man. This does not necessarily mean that heated milk is equal in all respects to raw milk, since such a conclusion could only be drawn if we knew all there is to be known about human nutrition and about the nutritive properties of milk, and this is far from being the case. So far as is known, the only significant changes effected in the composition of milk by heat are a partial loss of vitamin C and possibly of iodine. The amount of vitamin C in raw milk is in any case small and even in raw milk some loss usually occurs in course of distribution. These deficiencies

can be made good in the diet of babies fed exclusively on cows' milk by the addition of fruit or vegetable juice and cod-liver oil, and in the diets of children and adults by the other items in a good mixed diet which should always contain potatoes or other vegetables or fresh fruit and some sea fish. It is, therefore, reasonable to assume that heated or dried milk or milk incorporated in other cooked articles of diet such as bread and puddings retains most of the nutritional properties of raw milk.

The heating of milk, moreover, has important advantages in rendering it safe for consumption.

It is an unfortunate fact that milk is a medium through which disease may be conveyed to man. Milk is liable to become contaminated with the organisms of disease in two ways: (1) organisms may be transferred from a diseased cow to its milk and through the milk to man, and (2) organisms may be introduced into the milk from the milkers or other persons who handle and deal with it, or from infected utensils. These organisms, however, can be destroyed and the milk rendered safe for consumption by suitable heat treatment such as by efficient pasteurisation or boiling.

The ideal is milk from perfectly healthy cows, but herds in which all the cows are perfectly healthy are at present relatively few. Where such milk is not available the milk should be pasteurised or boiled before use.

The Effect of Manufacturing Processes on Milk.

When milk is submitted to processes resulting in the extraction of any of its solid constituents the nutritive value of any of the resulting fractions is, of course, lower than that of the whole of the original milk. The relative values of milk and its various derivatives are stated in Tables I and II.

The chief difference in nutritive value between separated milk and whole milk is due to the smaller amount of fat which the former contains. This defect of separated milk can be remedied by the inclusion of suitable fats in the diet. Furthermore, in an experiment carried out by Orr and his colleagues in which separated milk was given as a supplement to the ordinary home diets of school children it was found that separated milk was of high nutritive value.

Cream and butter are very valuable foods, but they cannot in any sense be regarded as complete foods because, for all practical purposes, their food value depends entirely on their content of easily digested and assimilated fat, the growth-promoting and protective vitamin A and variable but not very large amounts of the anti-rachitic vitamin D. They are, therefore, incomplete foods and in this respect compare very unfavourably with whole or even separated milk. Cream or butter is considered by many to be by far the most valuable constituent of milk: this is not the case, for cream or butter contains only three of the essential dietary constituents whereas whole milk contains all of them and separated milk the great bulk of them.

The high nutritive value of cheese can be seen by comparing it with its nearest equivalent, dried milk. (See Table I.) The most marked difference is that the carbohydrate content of dried milk is about 11 times that of cheese. Cheese contains relatively less of the B and C vitamins and of certain minerals than whole milk. To this extent, at least, cheese is inferior in nutritive value to whole liquid milk.

The nutritive value of whey is considerable, as can be seen from Tables I and II. It is relatively rich in sugar and mineral elements and also contains significant amounts of protein and the B and C vitamins. It is, like butter or cream, an imperfect food and its proper place in a diet, like that of butter or cream, would be to compensate for corresponding deficiencies in other imperfect foods. Thus whey would add considerably to the nutritional value of a diet containing cereals and cereal products.

TABLE I.

Approximate Composition of Milk and Milk Products.

Food	Protein	Fat	Carbo-hydrate	Cal-cium	Phos-phorus	Iron	Sulphur	Mag-nesium	Potas-sium	Sodium	Chlorine	Calories
Whole milk (grams per 100 ml.).	3·3	3·6	4·8	0·120	0·093	0·00024	0·034	0·012	0·143	0·051	0·106	378 per pt.
Separated milk (grams per 100 ml.).	3·4	0·3	5·0	0·122	0·096	0·00025	0·035	0·012	0·149	0·052	0·110	206 per pt.
Whey (grams per 100 ml.).	0·9	0·3	5·1	0·044	0·035	?	0·009	0·008	0·157	0·038	0·119	150 per pt.
Cream* (grams per 100 grams).	1·8	50·0	2·7	0·067	0·052	0·00022	0·019	0·007	0·080	0·028	0·059	2,123 per lb.
Butter (grams per 100 grams).	0·6	83·0	0·2	0·015	0·017	0·00020	0·010	0·001	0·014	—	—	3,281 per lb.
Cheese (grams per 100 grams).	25·7	35·0	3·1	0·931	0·683	0·00130	0·263	0·037	0·089	—	—	2,011 per lb.
Dried milk (grams per 100 grams).	23·8	26·0	34·1	0·840	0·651	0·00168	0·238	0·084	1·000	0·357	0·742	2,112 per lb.

* Cream may contain any proportion of fat from about 20 or 25 per cent. upwards. The figure of 50 per cent. given in the table is generally recognised as the approximate proportion for thick cream.

TABLE II.

Amounts supplied by Daily helpings in common use.
(Whey included for comparison).

Food.	Quantity.	Calories.	Protein grams.	Calcium grams.	Phosphorus grams.	Iron grams.	Sulphur grams.
Whole milk	1 pint	378	18·70	0·682	0·528	0·001363	0·193
Separated milk	1 pint	206	19·32	0·693	0·545	0·001420	0·199
Cream	¼ oz.	33	0·13	0·005	0·004	0·000016	0·001
Butter	1 oz.	205	0·17	0·004	0·005	0·000057	0·003
Cheese	½ oz.	63	3·65	0·132	0·097	0·000185	0·037
Whey	1 pint	150	5·00	0·250	0·200	?	0·051

Note.—It will be observed in this Table and in Table I that separated milk contains rather more of certain constituents than whole milk. To avoid possible misconception it should be pointed out that in the separation of the cream from whole milk, all the constituents, with the exception of fat, remain in the separated milk, practically in their entirety. Hence in one pint of separated milk the amounts of constituents other than fat are greater than those present in one pint of whole milk.

APPENDIX III.

Extract from the Report on the Physiological Bases of Nutrition drawn up by the Technical Commission of the Health Committee of the League of Nations.

PART I.

Energy, Protein and Fat Requirements.

All the figures on which the Commission has agreed are average values and it is essential that they should be interpreted in the light of this fact.

1. *Calorie Requirements.*

(*a*) An adult, male or female, living an ordinary everyday life in a temperate climate and not engaged in manual work is taken as the basis on which the needs of other age-groups are reckoned. An allowance of 2,400 calories net* per day is considered adequate to meet the requirements of such an individual.

(*b*) The following supplements for muscular activity should be added to the basic requirements in (*a*): †

Light work	...	up to	75 calories per hour of work.
Moderate work	...	,,	75–150 ,, ,, ,,
Hard work	...	,,	150–300 ,, ,, ,,
Very hard work	...	,,	300 calories and upwards per hour of work.

(*c*) The energy requirements for other ages and for mothers can be obtained from the following table of coefficients:

Age (years).	*Coefficient.*	*Calories.*
1–2	0·35	840
2–3	0·42	1,000
3–5	0·5	1,200
5–7	0·6	1,440
7–9	0·7	1,680
9–11	0·8	1,920
11–12	0·9	2,160
12–15‡	1·0	2,400
15 and upwards	1·0	2,400

* The term " net calories " refers to the amount of energy available from the food actually assimilated.

† For statistical purposes, to be comparable with previously adopted standards, 600 calories per day may be taken as an average supplement for muscular work.

‡ The needs of puberty are covered by giving the child of 12–15 years a calorie allowance corresponding to a coefficient of 1, with appropriate supplements for muscular activity and a protein allowance of 2·5 grammes per kilogramme of bodyweight.

The muscular activities characteristic of every healthy child and adolescent necessitate additions to the basic requirements shown in (*c*). It is suggested that the activities of children of both sexes from 5-11 years be considered as equivalent to light work, of boys from 11-15 years as moderate work and of girls from 11-15 upwards as light work.

	Coefficient.	*Calories.*
Women:		
Pregnant	1·0	2,400
Nursing	1·25	3,000

Allowance must also be made for women engaged in household duties, whether pregnant or not; these have to be reckoned as equivalent to light work for eight hours daily.

The requirements for babies under 1 year are difficult to specify except in terms of body-weight; the following allowances are considered adequate:

Age (months).	*Calories per kilogramme of body-weight.*
0–6	100
6–12	90

2. *Protein Requirements.*

In practice, the protein intake for all adults should not fall below 1 gramme of protein per kilogramme of body-weight. The protein should be derived from a variety of sources, and it is desirable that a part of the protein should be of animal origin.

During growth, pregnancy and lactation, some animal protein is essential, and in the growing period it should form a large proportion of the total protein.

The following allowances of total protein are recommended:

Age (years).	*Grammes per kilogramme of body-weight.*
1–3	3·5
3–5	3·0
5–12	2·5
12–15*	2·5*
15–17	2·0
17–21	1·5
21 and upwards	1·0
Women:	
Pregnant—0–3 months	1·0
4–9 ,, ...	1·5
Nursing	2·0†

* See footnote (‡) to paragraph 1 (*c*) above.
† See footnote (*) on page 20.

3. *Fat Requirements.*

Fat must be a constituent of the normal diet, but the data at present available do not suffice to permit a precise statement of the quantity required. The high content of vitamins A and/or D in certain fats justifies their use in liberal amounts.*

4. *The Influence of Climate on Dietary Requirements.*

In cold climates, the energy-content of the diet may need to be increased. Where climatic conditions or social customs do not permit of exposure to sunshine, vitamin D should be supplied in the diet.

PART II.

Mineral and Vitamin Requirements.

5. The Commission recognises the fact that the deficiencies of modern diets are usually in the *protective foods* (foods rich in minerals and vitamins) rather than in more strictly *energy-bearing foods* (rich in calories).

The term *protective food* denotes a foodstuff which is especially rich in those nutrient principles, "good" protein, vitamins or minerals, in which the principal foods of any geographic area are deficient.

Thus, e.g., in the United States of America—where the chief constituents of the daily diet are usually white bread and other foods made from white flour, sugar and muscle meats—milk and the leafy vegetables form the most important protective foods.

In other regions where the protein content of the diet is either too low or of poor quality (e.g., Asiatic diets consisting chiefly of polished rice or soja bean, with a small quota of green vegetables), meat would provide a highly valuable protective food.

In yet other areas where the diet consists almost exclusively of cooked or dry foods, fresh fruits and/or vegetables might be the most important protective food.

Among the protective foods are, first and most important, milk and milk products (including butter), eggs and glandular tissues; then green-leaf vegetables, fruit, fat, fish and meat (muscle). Among the energy-bearing foods of little or no protective power are sugar, milled cereals and certain fats.

Of energy-giving foods, unmilled cereals are not rich in protective nutrients and the more they are refined the less is their protective power. Many fats, especially when refined, possess little or no protective constituents. Refined sugar is of value only as a source of energy; it is entirely devoid of minerals and vitamins. The increasing habit in certain countries of large sugar consumption tends to lessen the amount of protective foods in the diet and is to be regarded with concern.

In cases where energy values are equal, protective foods should always be preferred.

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* See footnote (*) on page 20.

6. *Requirements of Pregnancy and Lactation.*

The Commission has attempted to define the quantitative needs of protective foods for perfect nutrition in terms of the requirements for the pregnant and nursing woman. She should be regarded as the member of the population needing the greatest " protection " in order to ensure adequate physical endowment for the child at birth and optimum nutrition during infancy.

The greatest difficulty in arranging such a diet is to provide adequate calcium, phosphorus, iron and vitamins B_1, B_2, C and D.

7. Milk, whole or skimmed, is a rich source of calcium salts and phosphates and of vitamin B_2, also a good source of vitamin B_1; milk fat is an excellent source of vitamin A. Eggs contain vitamins A, B_1, B_2, and D and are rich in iron. The proteins of milk and eggs are not only themselves of the highest nutritive value, but also improve the utilisation of the protein contained in cereals and vegetables. Milk has an additional advantage in that the abundance and availability of its calcium salts and phosphates enhance the effect of any vitamin D derived from other articles of diet or from sunshine. Milk, although itself poor in iron, renders more effective the iron contained in the diet.

8. Ordinary diets are usually inadequate in vitamin D and, except in sunny seasons and sunny countries, a small daily ration of cod-liver oil or other fish-liver oil rich in vitamin D is to be recommended in the diet of the pregnant and nursing mother and in that of the growing child. Fish-liver oils are also the richest known natural sources of vitamin A and are important sources of iodine. In goitrous regions, where sea-fish are not available, the provision of extra iodine in the form of iodised salt or in some other way is recommended.

9. An extended dietary use of the potato is recommended to replace part of the sugar and highly milled cereals in the ordinary diet. Potatoes provide extra vitamin C and more readily available calcium and phosphorus than are present in cereals. Potatoes also yield more iron and B vitamins than milled cereals.

The above paragraph applies to countries where potatoes are abundant, but it is of general application, due account being taken of local resources.

10. *Requirements of Other Adults and Children.*

In Tables I-VI, some simple schedules have been prepared to show how a selection of common protective foods will ensure safe intakes of the necessary protein, minerals and vitamins for a pregnant and nursing woman and for infants and children of ages up to 14 years. These are based on investigations made in the United Kingdom, the United States and Scandinavian countries, and are put forward to indicate how the dietary principles set forth in this report could be put into practice where these foods are available. In every locality, it will be necessary to discover the selection of food materials which is best adapted to national dietary habits and resources, and at the same time conforms to the needs of pregnancy, lactation and growth.

No attempt is made to lay down a detailed dietary programme, or to suggest the wide choice of protective and energy-yielding foods, whose selection will be influenced by availability, appetite and economic cost. Attention should, however, be directed to the value of the lightly milled cereals as a further source of iron and vitamin B_1, and of butter in preference to other common fats, because of its rich content of vitamin A.

The protective foods in Table I are arranged to yield approximately 1,400 calories without inclusion of cereals, fats or sugar; these can be added as required to satisfy the energy requirements of any individual. For adults other than the pregnant and nursing woman, the amount of protective foods might be reduced, if necessary, for economic reasons. For growing children, however, the maintenance of a high proportion of protective foods should be the aim.

In Tables II-VI, schedules are drawn up on the above basis for age-groups 0-1, 1-2, 2-3, 3-5, 5-7 and 12-14 years. Since the rate of growth of a child decreases with advancing age, it will be noted that the amounts of protective foods are not greatly increased for the older groups.

11. *General Recommendations.*

A. Although a *simplified* diet may be so constituted from a few protective foods as to be satisfactory, it is a general principle that *variety in diet* tends to safety, provided it contains a sufficiency of the protective types of food materials.

B. *White flour* in the process of milling is deprived of important nutritive elements. Its use should be decreased and partial substitution by *lightly milled cereals* and especially by *potatoes* is recommended. The consumption of an excessive amount of sugar is to be condemned, as it tends to lessen the proportion of protective foods.

C. Milk should form a conspicuous element of the diet at all ages. The Commission commends the tendency manifested in some countries to increase the daily intake up to one litre per day for pregnant and nursing women, as well as to provide an abundant supply for infants, children of all ages and adolescents. The practice of providing milk either free or at a reduced price to these groups is highly recommended.

The ration of milk indicated in Tables I-VI provides from 100-75 per cent. of the total calories during the first years of life, decreasing to about 50 per cent. at 3-5 years and to about 25 per cent. at the age of puberty. For the older groups, some portion of the milk or meat may be replaced by cheese.

The Commission desires to draw attention to the high nutritive value of *skimmed* and *separated milk,* which, although deprived of its vitamin A through removal of the fat, retains the protein, the B and C vitamins, the calcium and other mineral elements. The Commission deplores the large wastage in many countries of this valuable food.

D. Fresh vegetables and/or fruit should always be constituents of the normal mixed diet. Adequate provision of the vitamins other than vitamin D can be readily accomplished by inclusion in the diet of optimum amounts of protective foods.

E. The Commission emphasises the need for provision of *extra vitamin D,* wherever and whenever sunshine is not abundant, especially in the period of growth and during pregnancy. Where the appropriate rich foods are not available, only such *vitamin preparations as are officially controlled and approved* should be permitted. The indiscriminate use of irradiated foods, except in the case of milk, is deprecated.*

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* See footnote (*) on page 20.

12. *Problems recommended for Further Study.*

A. Assessment of the nutritional state of children.

B. Nutritive food requirements during the first year of life.

C. Minimum vitamin and mineral requirements.

D. Minimum fat requirements.

E. The nutritive and " supplementary " values of the different protein-containing foods, to determine to what extent and in what forms animal protein is necessary for growth and health.

F. The relative nutritive value of different cereals according to the degree of milling.

G. The extent to which the increasing consumption of sugar is detrimental to health.

H. Influence of climate on food requirements.

I. The extent to which diets in common use fall below the standards recommended in this report.

J. The optimum amounts of milk required at different ages.

TABLE

DIETARY SCHEME FOR THE

A. Protective Foods.

Food.	Amount.	Protein.	Calcium.	Phosphorus	Iron.	Iodine.
	Grammes.				Milligrammes.	
Milk	1,000	32	1·2	0·9	2·4	0·02–0·05
Meat (or fish or poultry) ...	120(*a*)	22	—	0·3	5·0 / 2(*a**)	—
Eggs (one)	50	6	—	0·1	1·5	—
Cheese (*c*)	30	8	0·3	0·2	0·4	—
Green and Leafy Vegetables...	100(*d*)	1	0·1	—	1·2	—
Potatoes	250	6	—	0·2	2·0	—
Legumes, Dried	10(*e*)	2	—	—	0·2	—
Cod-Liver Oil	3·5	—	—	—	—	Richest source
An available source of Vitamin C (from raw fruits and vegetables)	—	—	—	—	—	—
Total yield	—	77	1·6	1·7	10·2	Adequate

B.—Supplementary energy-yielding foods by means of which the individual's energy

Cereals as needed : Highly milled	250(*f*)	28	—	0·2	2·5	
or Whole grain...	250(*g*)	—	0·1	0·9	9·0	

Fats as needed.
Sugar as needed.

* The estimates are based on data in SHERMAN'S "Chemistry of Food and Nutrition", protein and 3·5 per cent. fat. The figures for vitamins, however, are converted to

I.*

PREGNANT AND NURSING WOMAN.

Vitamin A.	Vitamin B_1	Vitamin B_2	Vitamin C.	Vitamin D.	Calories.	Remarks.
International Units.			International Units.			
Rich (1,000–3,000)	Good (50–75)	Rich	Poor	Poor	660	(*a*) Calculations for lean meat.
Poor	Poor(*b*)	Rich	Poor	None	240	(*a**) One-half calculated as available iron.
Rich (1,000–1,300)	Good (about 15)	Rich	None	25–40	70	(*b*) Except glands (liver and kidneys) and pork muscle.
Rich (800–1,000)	Poor	Good	Poor	Poor	125	(*c*) Calculated as cheddar cheese.
Rich (1,000–1,500)	Good	Good	Poor	None	30	(*d*) Estimated on basis of $\frac{1}{3}$ cabbage, $\frac{1}{3}$ lettuce, $\frac{1}{3}$ spinach.
Poor	Good	Good	Good	None	250	
Poor	Good	Good	None	None	35	(*e*) Calculated as beans.
Rich (1,800–3,500)	None	None	None	Rich (about 300)	30	
—	—		To yield 250–500	—	—	
Over 5,000	Over 150	Ade-quate	Over 500	About 300	1,440	

requirements can be met.

	Rich (about 250)				1,000	(*f*) Calculated as white flour.
					1,000	(*g*) Calculated as whole wheat.

4th edition, 1933. The figures for milk are calculated for a content of 3·2 per cent. international units and must be regarded as rough approximation only.

Infants 0 to 1 year.

Breast-feeding is strongly recommended during the first 8-9 months of life. Even when the mother's diet and condition of life are suited for satisfactory lactation, the infant should receive supplements of (i) fresh fruit and/or vegetable juice to provide antiscorbutic vitamin C and (ii) whenever abundant sunshine is not available, a small daily ration of cod-liver oil of good quality, increasing gradually to 6 grammes daily, to provide vitamin D.

Artificial feeding.—When breast-feeding is not possible, the basis of the infant's diet should be milk supplemented by an adequate amount of substances rich in vitamins A, C and D. In cases where only partial breast-feeding is practicable, the supplementary diet should consist of milk and other suitable protective foods. Milk should always be pasteurised or raised to the boil to obviate the risk of milk-borne infections.

Prevention of anæmia.—The infant's reserves of iron salts being small and usually exhausted before the sixth month and milk being deficient in this essential dietary element, the addition to the diet of all infants of small amounts of foods rich in iron is advocated from an early age. Foods recommended are egg yolk, if tolerated by the infant, or purées of green vegetables or carrots; in special cases, direct administration of iron salts may be ordered by the physician.

Premature infants, whether breast-fed or artificially fed, have even greater need than normal infants for supplementary vitamin and mineral additions to the diet. These should be begun in the first days after birth. Artificial vitamin D concentrates should only be given under medical supervision, in order to avoid the risk of over-dosage.

Cereals.—The practice of giving cereal foods before the age of 6 months is not advised; after this age, the use of potatoes, suitably prepared, is advocated, as a partial or complete substitute for cereals.

Fat.—Milk containing 3-3·5 per cent. fat is recommended as most generally suited for infant feeding, since large amounts of fat tend to interfere with digestion and to cause fat intolerance.

TABLE II.

Children, age 1–2 years (840 calories).

Food.	Amount. (grammes).	Calories.	Protein. (grammes).
A. Protective Foods.			
Milk	750	490	24
1 Egg (or equivalent, as 30 grammes meat or fish or liver, if available) ...	48	70	6
Green leafy Vegetables	30–60	15	—
Potato (or Carrot)	30	30	—
Cod-Liver Oil	3	30	—
		635	30
B. Supplementary Energy-yielding Foods.			
Fats (butter, if possible)	7	50	—
Cereals (calculated as bread)	50	150	7
Total		835	37

TABLE III.

Children, age 2–3 years (1,000 calories).

Food.	Amount. (grammes).	Calories.	Protein. (grammes).
A. Protective Foods.			
Milk	1,000	660	32
1 Egg (or equivalent, as 30 grammes meat or fish or liver, if available) ...	48	70	6
Green leafy Vegetables	30–60	15	—
Potato (and other root vegetables) ...	50	50	1
Cod-Liver Oil	3	30	—
A source of vitamin C (raw vegetable or fruit).			
		825	39
B. Supplementary Energy-yielding Foods.			
Fats (butter, if possible)	10	75	—
Cereals (calculated as bread)	50	150	7
Total		1,050	46

TABLE IV.

Children, age 3–5 years (1,200 to 1,300 calories).

Food.	Amount. (grammes).	Calories.	Protein. (grammes).
A. Protective Foods.			
Milk	1,000	660	32
1 Egg (or equivalent, as 30 grammes meat or fish or liver, if available) ...	48	70	6
Green leafy Vegetables...	60–100	20	2
Potato (and other root vegetables) ...	100	100	2
Cod-Liver Oil	3	30	—
A source of vitamin C (raw vegetable or fruit).			
		880	42
B. Supplementary Energy-yielding Foods.			
Fat (butter, if possible)	15	110	—
Cereals (calculated as bread)	75	225	11
Total		1,215	53

TABLE V.

Children, age 5–7 years (1,400 calories).

	Food.	Amount. (grammes).	Calories.	Protein. (grammes).
A.	*Protective Foods.*			
	Milk	1,000	660	32
	Egg	48	70	6
	Meat, Fish, Liver or Cheese	30	40	6
	Green leafy Vegetables	100	30	3
	Potato (and other root vegetables) ...	150	150	3
	Cod-Liver Oil	3	30	—
	A source of vitamin C (raw vegetable or fruit).			
			980	50
B.	*Supplementary Energy-yielding Foods.*			
	Fats (butter, if possible)	20	150	—
	Cereals (calculated as bread)	100	300	14
	Total		1,430	64

TABLE VI.

Children, age 12–14 years (2,600 calories (girls), 3,200 calories (boys)).

	Food.	Amount. (grammes).	Calories.	Protein. (grammes).
A.	*Protective Foods.*			
	Milk	1,000	660	32
	1 Egg	48	70	6
	Meat or Fish or Liver or Cheese ...	90	120	18
	Green leafy Vegetables	250	75	7
	Potato (and other root vegetables) ...	300	300	6
	Cod-Liver Oil	3	30	—
	A source of Vitamin C (raw vegetable or fruit).			
			1,255	69

B. *Supplementary Energy-yielding Foods.*

Fats (butter, if possible), cereals and other foods to furnish total calories as required.

APPENDIX IV.

Conversion Factors for Meat, etc.

Wastage in distribution was considered in 1916 by a Committee of the Royal Society on Food Supplies during the War and deductions were made varying with each food so as to express it in terms of pure nutrients (protein fat and carbohydrate, etc.) and to estimate the number of calories provided. Figures for protein and carbohydrate, which appear in the Royal Society's Report on Food Supplies (1917) were based on the work of Atwater and Plimmer, who, so far as meat is concerned, merely made laboratory estimations of actual joints and assumed that these were representative of all carcases.

Research has been undertaken with a view to revising the existing conversion factors for meat, the first objective being to ascertain the food values of the total bacon consumed in this country. With the co-operation of the Bacon Development Board and the Danish Bacon Company representative samples of bacon and ham were obtained and after mincing were sent to Dr. R. A. McCance of King's College Hospital for analysis. The cutting, anatomical measurements, mincing, weighing and packing were carried out at the factory of Messrs. T. Wall and Sons, Ltd., Acton, under the supervision of Dr. J. Hammond, of Cambridge University, and Mr. A. N. Duckham, of the Bacon Development Board. Samples of boneless beef were also obtained and sent to Dr. McCance for analysis. The results for bacon and ham will shortly be published. Preliminary results indicate that there are a higher proportion of protein and a lower proportion of fat in the bacon and ham supply than are indicated in earlier analyses. This is shown in the following table:—

Comparative Analyses of Bacon and Ham.

	Per 100 grams.		
	Protein.	*Fat.*	*Energy Value (Calories)*
1. *Dr. McCance (1936).*			
Tank Cured Wiltshire Side (Danish) ...	14·3	37·1	404
Dry Cured Wiltshire Side (British) ...	12·3	49·3	509
Midland Cut (British Shoulder Belly) ...	10·5	61·1	611
York Ham (British)	15·	49·	517
2. *Plimmer (1918).*			
Bacon Side (type unspecified)	9·7	55·7	558
Ham ,, ...	13·1	46·0	482
3. *Atwater and Bryant (1906).*			
Bacon "Edible Portion"	10·5	64·8	646
Ham Smoked "Edible Portion" ...	16·5	38·8	429

These values exclude the weight of bone but include that of rind, the nutritive value of the rind being also included. (Whether rind was included in Atwater and Bryant's "Edible Portion" value is uncertain.)

The following Table shows the results of Dr. McCance's analyses of frozen meat:—

Estimated Composition of Frozen Meat.

—	Veal.			Beef.				
	Source.		Mean.	Source.				Mean.
	New Zealand.	Uruguay.		Australia.	Argentine.	New Zealand.	South Africa.	
	gm./100 gm.	gm./100 gm.	gm./100 gm.	gm./100 gm.	gm./100 gm.	gm./100 gm.	gm./100 gm.	gm./100 gm.
Total nitrogen ...	3·1	3·2	3·15	3·40	3·08	3·8	3·35	3·41
Purine nitrogen ...	0·057	0·045	0·051	0·052	0·053	0·056	0·048	0·052
Fat	2·66	4·6	3·63	6·65	12·0	1·8	8·5	7·24
Water	75·2	75·4	75·3	67·6	66·3	73·6	70·3	69·45
	mg./100 gm.	mg./100 gm.	mg./100 gm.	mg./100 gm.	mg./100 gm.	mg./100 gm.	mg./100 gm.	mg./100 gm.
Sodium	95	94	95	82	77	61	73	73
Potassium... ...	380	375	378	365	338	445	338	396
Calcium	10·3	10·2	10·2	9·9	8·9	7·2	8·8	8·7
Magnesium ...	25	26·3	25·7	25·7	23	26	24·5	24·5
Iron	1·58	2·01	1·8	3·46	4·1	4·4	3·0	3·74
Copper	0·22	0·12	0·17	0·16	0·18	0·15	0·145	0·159
Phosphorus ...	210	190	200	197	205	200	188	198
Chlorine	94·5	101	98	89	70	57	77	73

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